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ASCORBIC ACID DEFICIENCY AMONG PAPAGO INDIANS

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INTRODUCTION

The Papago Indians, a people of Uto-Aztec origin, live in sequestered communities, among reservation lands of approximately 2,500,000 acres. These settlements extend along the frontier of Arizona and Sonora and are bordered by the Pima reservation on the north. The land itself is typically that of an Arizona desert, with vegetation of cactus, palo verde, mesquite and ironwood; it is an arid, forbidding, isolated region with very low precipitation.

The Papagos, over five thousand in number, pursue their temporal farming, much as they have always done, but in many instances a deculturation process has taken place with a change from a diet of wild plants and animals to one of more or less refined cereals and occasionally meat. The fact that the bean is the staple food of the Papagos is borne out by the name given to these Indians, "papawi o' otam," meaning "bean people."

The principal foods in the Papago diet are beans of several varieties: white, brown and yellow tepari (Phaseolus acutifolius), pink beans (Prosopis vulgaris), mesquite beans (Prosopis chilensis), and screw beans (Prosopis pubescens); garden peas (Pisum sativum), and black-eyed beans (Vigna sinensis), corn (Zea mays, amylacea), pumpkins (Cucurbita

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pepo; Cucurbita moschata), dried chili (Capsicum annuum), a native spinach or pigweed (Ameranthus Palmeri), and whole wheat and peeled wheat (Tricitum vulgare). The majority of these foods are dried for storage.

The Papagos utilize for consumption the available varieties of cactus as they did aboriginally, gathering the fruits of the cholla (Opuntia echinocarpa) and various other kinds of prickly pear (Opuntia spp.) and the sahuaro (Carnegiea gigantea). The fruits are eaten in large quantities during season and in most instances these are baked for 24 hours in pits partially filled with hot stones; the surplus is dried for storage. The sahuaro fruit is often prepared as a syrup or jam. The seeds of the cactus are dried and later these are ground into a meal from which they prepare a gruel. In most of their cooking the Papagos use quantities of fat, especially lard or vegetable shortening.

In general it can be said that the diet of these people is one rich in cooked carbohydrate, with occasional animal protein and, in rare instances, cooked green fruits or vegetables. The Papagos drink but little milk (except from the breast during infancy); most of the natives in the outlying districts drink no dairy milk at all. As a result of their diet numerous avitaminoses occur, superimposed one on the other; the deficiencies may be subclinical or threshold in character due to a continued shortage of vitamins in the diet.

ASCORBIC ACID STUDIES

Various studies in the literature indicate that the ascorbic acid content of the plasma and the amount excreted are an index of the previous dietary intake (Belser, Hauck and Storvick, '39; Heinemann, '38). On the other hand, reports have appeared where the blood analyses themselves are used to determine the actual state of ascorbic acid nutrition (Minot, Dodd, Keller and Frank, '40). In some instances the blood and urine analyses have been supplemented by the determination of ascorbic acid in the dietary intake (Todhunter and Robbins, '40; Goldsmith, Ogaard and Gowe, '41). However, as Bessey and White ('42) have pointed out, the practical problem is one

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which involves the dietary intake and the level of ascorbic acid in blood plasma. The dietary intake of ascorbic acid found necessary to maintain a plasma level of this organic acid has varied with the techniques used by investigators. Widenbauer ('37) determined that a daily intake of 22 mg. was necessary to maintain a fixed plasma ascorbic acid concentration; Hathaway and Myer ('41) reported 31 mg., and Bessey and White ('42) in careful studies of children arrived at the conclusion that 3 ounces of orange juice plus what was present in the diet seemed an ideal intake to maintain a level of presumably 40–50 mg. a day. It can be assumed, on the basis of such investigations, that from 30–50 mg. are required to sustain ascorbic acid economy. It is not the purpose of this communication to ascertain the ascorbic acid requirements of Papago Indians but rather to ascertain the amount of ascorbic acid in their food and the plasma level. At the onset we were intrigued by the frequent occurrence among the Papagos of the common finding of a hemorrhagic diathesis in their gums, and in some cases on the ankles and other portions of the body that were most subject to trauma. We felt that the disease of latent or subclinical scurvy was a possibility among these people and that this deficiency might be responsible for its numerous insidious effects.

The method of assay for plasma ascorbic acid was that of Mindlin and Butler ('38) but without the use of cyanide; and that described by Bessey ('38) for foods. Two groups of children, from 6 to 15 years of age, were studied: a group at the Sells School where school lunches are provided, and a group in an isolated community known as Cowlic. School children were used because they were more acculturated and cooperative, the adults being quite primitive and to a greater degree intractable and less amenable to study.

The plasma ascorbic acid findings among twenty-eight children were as follows: one child had a value of 0.660 mg. per cent, which was the highest content observed; two had values of 0.528 mg. per cent, and the rest varied from the lowest ascorbic acid content of 0.264 mg. per cent to 0.396 mg. per cent.

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146 In view of the fact that a plasma level of 0.8 to 1.0 mg. per cent appears to be the normal range for medical students (Pijoan and Klemperer, '37), the values expressed in the foregoing paragraph are low enough to indicate a continued shortage of this vitamin in the diet. Furthermore, the subjects studied were those in whom no wasting or progressive debilitating disease could be found. In short, it would appear that these subjects were good candidates for the study of vitamin C nutrition.

146 In the Papago village of Cowlic, the diet is low in ascorbic 262 acid. It consists predominately of beans and home-made bread together with meat occasionally (possibly once a week, and used as a seasoning), and occasionally cooked pumpkins and cactus fruits.

146 No ascorbic acid was found in our assays of all of the various types of uncooked and cooked beans, corn, peas and dried cactus seeds. The only sources of ascorbic acid we are aware of in the Papago diet are as follows (in milligram per 100 gm.): Sahuaro cactus fruit 3.52; dried red chile 14.46; dried cactus buds (cholla) 1.48; spinach (pigweed) 3.72; wheat flour 2.7; and squash 2.75. Since most of these foods are consumed after they have been cooked, and since no "cooking time" (by boiling) was less than 20 minutes on the part of the natives, the same foods (2-gm. samples in 15 cc. water) were subjected to boiling (97°C., alt. 5600 feet) for 20 minutes. The ascorbic acid content in milligram per cent weight plus that in the water used for cooking was as follows: Sahuaro cactus fruit 1.76 mg., dried red chili 9.57 mg., dried cactus buds 1.16 mg., spinach (pigweed) 1.32 mg., wheat flour 1.5 mg., and squash 1.2 mg. Other foods consumed contained values as follows: bread 1.7 mg., and Sahuaro cactus fruit syrup 8.96 mg.

In a diet consisting essentially of cooked carbohydrate, where chili and other ascorbic acid-containing foods are only incidental, the ascorbic acid content never exceeds 15 mg. a day and is, generally speaking, on an average of about 5 mg. a day. Bleeding of the gums occurs in 70% of the Indians, [164] and pyorrhoea is present in all the older adults examined.

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Ascorbic acid insufficiency may presumably be a cause for such findings. Saturation studies with determinations of the urinary excretion are impractical in field work and in our opinion the circumstances would introduce a considerable source of error.

DISCUSSION

Among Papago Indians there is an obvious insufficiency of ascorbic acid in the diet. The plasma levels of ascorbic acid in the Papago Indians studied are in general not those characteristic of scurvy but indicate rather the beginning of subclinical scurvy. In some cases where the value is below 0.3 mg. per cent, certain stigmata of early scurvy can be found, such as bleeding gums, hemorrhagic diatheses about the ankles and heels, and loose teeth. The other vitamin deficiencies present somewhat confused the clinical picture. This was found to be the case also among Shoshone and Taos Indians, as well as among Spanish Americans (Pijoan and Eggan, '43). These people have dietary food patterns which have points of similarity, namely, that carbohydrates and proteins are derived largely from cooked legumes. The body economy as studied by Pijoan and Eggan ('43) is a poor one and the numerous deficiencies form vicious circles involving infections. The introduction of synthetic vitamin preparations or foods foreign to their culture has been attempted and their use is of short duration, as such preparations have no cultural significance and the medical results are slow and undramatic. The solution of the problem of ascorbic acid nutrition among Papago Indians so far evades us. Among certain peoples where citrus fruits, tomatoes and strawberries are part of their culture, the increased use of such foods as a curative measure of a deficiency is a simple one. In other areas, such as Taos, New Mexico, decoctions of pine needle juice or chili juices can supply the necessary ascorbic acid and their use can fit into the acculturation process. No plants having a high ascorbic acid content can be found in the Papago reservation, even though the use of green peppers or seed sprouts might play a role in increasing the source of ascorbic acid. From a nutritional point of view the problem is a provocative one and merits attention.

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CONCLUSION

146 Papago Indians have an inadequate intake of ascorbic acid in their dietary food pattern and a resulting low plasma level. The nutritional and cultural aspects of this problem are discussed.

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